ASSESSMENT OF WATER QUALITY PARAMETERS IN LAKE ALAU

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ABSTRACT

The physico-chemical parameters of Lake Alau were monitored for four months to assess the water quality. Parameters such as temperature, transparency, conductivity, dissolved oxygen, biochemical oxygen demand, Ca, P, etc were studied in five stations (A, B, C, D and E). Water samples were collected monthly from 8:00 to 12:00noon, for four months (July - October 2008, wet season) and analysed. The physico-chemical parameters were within the ranges of unpolluted water bodies. Variation occurs in almost all the months of the study. Significant difference ($P<0.05$) occurred in p^H, transparency and Ca among the stations, and insignificant difference ($P>0.05$) in temperature, conductivity, dissolved oxygen, biochemical oxygen demand, Mg and P. These variations may be due to effects of fertilizer application, herbicides and insecticides in irrigated farms around the Lake.

INTRODUCTION

The quality of water plays a vital role in the productivity of aquatic habitats. The fertility of water is related to its chemical properties and understanding of water chemistry serves as basis for considering whether the water is rich or poor in biological production. The physical and chemical properties of water greatly influence the uses, the distribution and richness of biota (Courtney and Clement 1998). As such, techniques of using physical and chemical properties to assess water bodies are essential. And it will also reveal the concentrations of known environmental contamination which could render such water unfit for human consumption and other purposes. Properties such as high dissolved oxygen in water is an essential pre-requisite for satisfactory aquatic life, while presence of dissolved oxygen and carbon (IV) oxide in water for industrial purposes constitute corrosive agents and threatens the life of most metallic plants (Akpan 1995). The objectives of this study were to assess the physio-chemical parameters of Lake Alau, and compare the water quality parameters with the standard required levels for fish production.

METHODOLOGY

Lake Alau is one of the largest water bodies in Northeast Nigeria. It was sourced from river Ngadda. It is located about 19km from Maiduguri along Maiduguri-Bama road, between latitude $10^0 43^I$N and longitudes $10^0 15^I$E and $13^0\ 17^I$E (BSMLS, 2002). It has two distinct wet and dry seasons; a raining season with mean annual rainfall of about 600mm from July to October, and a hot dry season from March to July. The dry season is preceded by a period of dry Harmattan with very low temperature and dry hamatan wind between November and February (Bankole *et al.* 1984). Monthly surface water samples were collected in duplicate for a period of four months (July 2008 to October 2008) with two litre plastic containers. The containers were washed with detergent, rinsed with 0.1m HCL and finally rinsed with distilled water. Collections were made between 8:00am and 12:00noon. Five sampling stations were demarcated from the lake station A, B, C, D and E respectively. Station A serves as the control which is the inlet of the water body. Standard method from APHA(1998) was adopted for this study. Temperatures were measured with mercury in glass thermometer while transparency was measured with a Secchi disk. Conductivity and p^H were measured using individual meters. DO meter was used to determine the dissolved oxygen and Winkler method was used to determine BOD. The concentration of TDS was determined by evaporation process while that of TSS was by filtration method. Total alkalinity and salinity were analyzed by titrimetric method. Colorimetric method was adopted for Nitrate-nitrogen (NO_3N) and Phosphate phosphorus (PO_4-O).

RESULTS AND DISCUSSION

The monthly mean value of the physicochemical parameters of Lake Alau is given in Table 1, while that of monthly mean by sampling station of physicochemical parameters is given in Table 2. Physicochemical analysis showed that temperature was low in September ($27.42^{\pm}0.29^0$C) and high in

July (28.24±0.34). However, other low values were recorded in August and October with no significant difference (P>0.05). The lowest value was recorded in station C (27.55±0.35) and the highest value in station A (28.00±0.45). There was no significant difference between all the stations (P>0,05). The low temperatures recorded fom August to September which is due to the cloudy weather caused the decrease in temperature. This in accordance with the works of Timms (2001), which noted that climatic factors were the determining factor for increase or decrease in temperature in the arid zone and lake Alau shore the climate of the northeast arid zone. The water temperature of the range in this study falls within the normal range (25.0-35°) of natural tropical waters (Allabaster and Lyod 1980). The aquatic life of the tropics are adopted to these changes (Wood et al, 2002).

Table 1: Monthly mean of some physicochemical parameters of Lake Alau 2008

Months	Temp (°C)	Conduct (N/cm)	pH	DO (mg/L)	Transp (m)	BOD (mg/L)	Ca	Mg	P
July	28.24^{a}	65.80^{a}	8.476^{a}	3.76^{b}	0.852^{a}	2.38^{a}	0.84^{a}	1.20^{c}	0.09^{a}
August	27.92^{a}	51.04^{b}	7.90^{ab}	4.82^{a}	1.204^{a}	2.68^{a}	0.84^{a}	2.50^{a}	0.1122^{a}
Sept.	27.42^{c}	68.00^{a}	7.468^{ab}	3.34^{b}	1.38^{a}	1.20^{b}	0.36^{c}	0.84^{d}	0.212^{a}
October	27.96^{a}	66.40^{a}	7.124^{c}	3.34^{b}	1.18^{a}	1.40^{b}	0.66^{ab}	1.48^{b}	0.28^{a}

Table 2: Monthly mean of some physicochemical parameters of Lake Alau 2008 by Sampling Stations

Stations	Temp (°C)	Conduct (N/cm)	pH	DO (mg/L)	Transp (m)	BOD (mg/L)	Ca	Mg	P
A	28.00^{a}	61.75^{a}	7.0625^{b}	3.525^{a}	1.5375^{a}	1.925^{a}	0.425^{b}	1.40^{a}	0.3025^{a}
B	28.25^{a}	60.77^{a}	7.99^{ab}	3.675^{a}	1.0375^{bc}	1.85^{a}	0.725^{ab}	1.525^{a}	0.155^{a}
C	27.55^{a}	60.75^{a}	7.915^{ab}	4.30^{a}	1.45^{ab}	2.175^{a}	0.90^{a}	1.45^{a}	0.175^{a}
D	27.95^{a}	66.00^{a}	7.0925^{b}	3.70^{a}	1.015^{bc}	1.925^{a}	0.525^{ab}	1.75^{a}	0.11775^{a}
E	27.679^{a}	64.775^{a}	8.65^{a}	3.875^{a}	0.73^{c}	1.70^{a}	0.80^{ab}	1.40^{a}	0.1275^{a}

Key:

A= Akurari (control), B= Usmanti, C= spillway, D= Abbari, E= Ngawofete

- Value with same supper script are no significant different (P<0.05)

Conductivity was low August (51.04±6.52) and high in September (68.00±10.56) during the wet season. In terms of stations lowest value was recorded in station C (60.75±3.77) and highest in station D (66.0±8.68). Also lower values were recorded in station A, B, and E although there was no significant difference between the stations (P>0.05). The specific conductance of the lake water was less than 600u/cm recorded from Kiri dam (Ovie et al., 2000). The maximum value of 82u recorded for lake Alau in wet season is another indication of oligotrophy. It implies low level of dissolved salts, a characteristic feature of "soft" water. pH was low in October (7.12±0.72) and high in July (8.48±1.06) with slight difference compared to the rest of the months. In terms of stations, lowest values were recorded in station A (7.06±0.44) and highest value in station E (8.65±0.77). Very slight variations occurred between the sample stations. There was significant difference (P<0.05) between station A, D and E and no significant difference (P>0.05) between station B and C. The values and status in the p^{H} of lake Alau agree with the observation of Hanson et al.(1990) in Zambezi river, Elemi (1990) in Ona river, Atama, (2003) in Rimco reservoir, but contradicted the trend in some African lakes in which pH is lower in wet season, but rises during dry season (Azionu 1983). The pH ranges of lake Alau were comparatively narrow and fall within the recommended range (6.5-9.0) as sustainable for aquatic life (Boyd, 1979).

The DO concentration in the Lake was low in October (3.34±0.25) and high in August (4.82±1.84). In terms of stations, lowest value was recorded in station A (3.53±0.15) and highest in station C(4.30±1.21). There was no significant difference between all the stations (P>0.05). The pattern of dissolved oxygen varied between stations. Egborge (1979) observe similar pattern of variation in lake Asejire. Oxygen levels in the in the five stations sampled were statistically proved to be significant. Duncan (1975) considered that whereas wind is a major oxygenator in large lakes,

while in smaller lakes, is largely determine by phosynthetic action of phytoplankton. Complete Oxygen depletion was not observed in any of the stations in the lake, apparently because of significant water movement throughout the lake.

Low transparency was recorded in the month of July ($0.85^{\pm}0.20$) and high in September ($1.38^{\pm}0.41$). In terms of stations, lowest value was recorded in station E ($0.73^{\pm}0.13$) while the highest value was in station A($1.54^{\pm}0.35$). There was significant difference between station A, C and E ($P<0.05$), and no significant difference between station B and D ($P>0.05$). Water transparency varied from (0.6-1.87) in five stations. This is very low compared to 0.45-2.8m obtain in Kainji lake, (Adeniji, 1975). The remarkable increase in August after the on set of rains indicates that less floods draining into the lake were responsible for high water transparency within that period rather than phytoplankton production. Biwas (1978) observed in lake Volta Ghana, secchi disc transparency decreased with increased in phytoplanktons.

BOD was low in September ($1.2^{\pm}0.61$) and high in August ($2.68^{\pm}0.77$), other high values were recorded in July. The lowest values were recorded in station E ($1.70^{\pm}1.12$) and the highest in station C ($2.18^{\pm}1.46$). There was no significant difference between all the stations ($P>0.05$). Kolo and Yisa (2000) observed that organic matter decomposition from increased human activities can increase BOD variation. Moore and Moore (1976) reported that BOD is a fair measure of cleanliness of any water and classified values of less than 1.2mg/l as clean, while 4-6mg/l as fairly clean, and 8-10mg/l as bad and polluted. Base on these values, lake Alau water may be considered as clean.

Ca was low in September ($0.36^{\pm}0.05$) and high in July ($0.84^{\pm}0.29$). The value obtained in July, August and September are significantly different compared to the month of October ($P<0.05$). Station A recorded lowest value of $0.43^{\pm}0.01$ and highest value in Station C ($0.90^{\pm}0.42$). The values obtained in Station A and C are significantly different compare to Station B, D and E ($P<0.05$). This agrees with findings of Amuzu et al., (1990) that heavy metals occur in low concentration in aquatic ecosystem. Hart (1993) classified a surface water with <0.2mg/l of calcium as very low, 0.2-0.3mg/l as low, 0.3-0.6mg/l as moderate, 0.6-1.2mg/l as high polluted and >1.2mg/l very high and heavily polluted. As such lake Alau is unpolluted. Mg was low in September ($0.84^{\pm}0.21$) and high in August ($2.50^{\pm}0.22$). There was no significant difference among all the months ($P>0.05$). Station A recorded the lowest value of $1.40^{\pm}0.57$ and highest in station D ($1.75^{\pm}0.76$). There was significant difference between all the stations ($P<0.05$). Odieta (1999) reported that domestic sewage and agricultural effluents has capacity to precipitated manganese salts, which may exert a toxic effect on the aquatic organism. Other sources may be due to localized inputs and sediments transport. Low P was recorded in July ($0.10^{\pm}0.05$) and high in October ($0.28^{\pm}0.25$). The lowest value was recorded in station D ($0.12^{\pm}0.13$) and highest in station A ($0.30^{\pm}0.28$). There was no significant difference between all the stations ($P>0.05$). It has also observed during this study period intensive agricultural activities involve use of fertilizer and pesticides to produces crop vegetables. Some villages where using the water for domestic activities, washing vehicles, which could increase the P level of the lake water. Sandra (2000) observed that P is the most important and limiting substances controlling organic production.

The physicochemical parameters of Lake Alau varied with months and stations, due to their specific properties during the wet season. The limnological features strongly suggest that the water body is maintaining an oligomesotrophic status. The Physio-chemical parameters were within the ranges in unpolluted water bodies. Variation may be due to effect of agricultural activities through fertilizer applications, herbicides and pesticides around the lakes catchments. Furthermore, these findings provide baseline information on some aspects of water quality status as well as the tropic status of the lake. The baseline information will serve as an indicator for ecological problems and action to minimize likely problem with respect to its sustainable management. In order to upheld United Nation Organization standards (UNO, 1992) that all species and habitats should be safeguarded to the extent that is technically, economically, and politically feasible, the following recommendations should be adopted.

1. Settlements around Lake Alau should be encouraged to adopt environmentally friendly initiatives by embracing Low and Non-waste Technologies (LNWT) at all stages of product life.
2. Monitoring of Lake Alau should be encourage as part of environmental management policy, so as to control the effluents that enter each station, through canals, washing, etc, and hence

maintain acceptable units of metal concentration, such as nitrate, nitrogen and phosphorus, that encourages eutrophication of lake.

3. Substantial limnological research information has accrued from a relatively short period of research work, longer period oriented study becomes increasingly vital and desirable. Further prolonged research should be carried in order to provide a broader understanding of this very economically and scientifically important water body in the arid zone. In addition, the knowledge derived should be used as an index for other man-made lakes in the arid zones.

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